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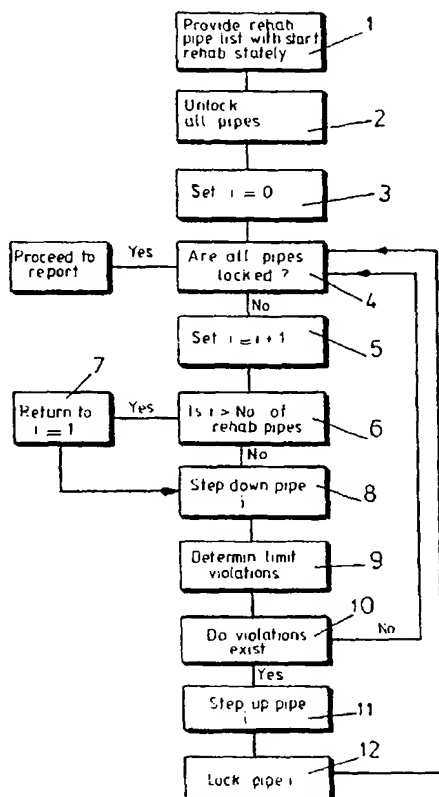
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[Continued on next page]

(54) Title: PIPE NETWORK OPTIMISATION



(57) Abstract: A method of optimising a model of pipe network with respect to a predetermined criteria, such as costs. In particular, the method provides an efficient way of minimising the cost of rehabilitating a water pipe network. The invention provides a method of optimising proposals for pipes within a network without violating operating criteria of the network. The invention further provides the methods of determining the hydraulic significance of pipes within a pipe network, and determining the peak flow requirements of each pipe.

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## INTERNATIONAL SEARCH REPORT

International Application No

PCT/GB 01/03349

A. CLASSIFICATION OF SUBJECT MATTER  
IPC 7 G06F17/50

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

IPC 7 G06F

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EP0-Internal

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	M. COLLINS: "SOLVING THE PIPE NETWORK ANALYSIS PROBLEM USING OPTIMIZATION TECHNIQUES" MANAGEMENT SCIENCE, vol. 24, no. 7, March 1978 (1978-03), pages 747-760, XP001033599 USA page 748, line 7 -page 755, line 20 ---	1
A	US 4 200 911 A (MATSUMOTO KUNIAKI) 29 April 1980 (1980-04-29) column 3, line 4 -column 7, line 25 --- -/--	1

☒ Further documents are listed in the continuation of box C.☒ Patent family members are listed in annex.

\* Special categories of cited documents:

- \*A\* document defining the general state of the art which is not considered to be of particular relevance
- \*E\* earlier document but published on or after the international filing date
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- \*O\* document referring to an oral disclosure, use, exhibition or other means
- \*P\* document published prior to the international filing date but later than the priority date claimed

\*T\* later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

\*X\* document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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Date of the actual completion of the international search

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# INTERNATIONAL SEARCH REPORT

Intel      onal Application No

PCT/GB 01/03349

## C.(Continuation) DOCUMENTS CONSIDERED TO BE RELEVANT

Category *	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	J.ZHANG ET AL: "A BILEVEL PROGRAMMING METHOD FOR PIPE NETWORK OPTIMIZATION" SIAM JOURNAL ON PTIMIZATION, vol. 6, no. 3, August 1996 (1996-08), pages 838-857, XP001032941 USA page 839, line 1 -page 842, line 24 ---	1
A	G.XUE ET AL: "COMPUTING THE MINIMUM COST PIPE NETWORK INTERCONNECTING ONE SINK AND MANY SOURCES" SIAM JOURNAL ON OPTIMIZATION, vol. 10, no. 1, 1999, pages 22-42, XP001032937 USA page 23, line 27 -page 29, line 34 ---	1
A	E.MATHEWS ET AL: "A NUMERICAL PTOMIZATION PROCEDURE FOR COMPLEX PIPE AND DUCT NETWORK DESIGN" INT.J.NUM.METH.HEAT FLUID FLOW, vol. 5, no. 5, July 1995 (1995-07), pages 445-457, XP001033595 UK page 451, line 9 -page 452, line 6 ---	1
A	T.LEKANE ET AL: "LONG-TERM OPTINIZATION MODEL OF TREE WATER NETWORKS" EUR.J.OPER.RES., vol. 4, no. 1, January 1980 (1980-01), pages 7-15, XP001033597 THE NETHERLANDS page 8, left-hand column, line 36 -page 11, right-hand column, line 34 ---	1
A	D.SAVIC ET AL: "GENETIC OPERATORS AND CONSTRAINT HANDLING FOR PIPE NETWORK OPTIMIZATION" SELECTED PAPERS.EVOLUTIONARY COMPUTING.AISB WORKSHOP, 3 April 1995 (1995-04-03), pages 154-165, XP001033594 GERMANY page 155, line 33 -page 158, line 17 -----	1

# INTERNATIONAL SEARCH REPORT

International application No.  
PCT/GB 01/03349

## Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This International Search Report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:  
because they relate to subject matter not required to be searched by this Authority, namely:
  
2. ☐ Claims Nos.:  
because they relate to parts of the International Application that do not comply with the prescribed requirements to such an extent that no meaningful International Search can be carried out, specifically:
  
3. ☐ Claims Nos.:  
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

## Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

see additional sheet

1. ☐ As all required additional search fees were timely paid by the applicant, this International Search Report covers all searchable claims.
  
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
  
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this International Search Report covers only those claims for which fees were paid, specifically claims Nos.:
  
4. ☒ No required additional search fees were timely paid by the applicant. Consequently, this International Search Report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

1-23

Remark on Protest

- ☐ The additional search fees were accompanied by the applicant's protest.
- ☐ No protest accompanied the payment of additional search fees.

FURTHER INFORMATION CONTINUED FROM PCT/ISA/ 210

This International Searching Authority found multiple (groups of) inventions in this international application, as follows:

1. Claims: 1-23

A method for optimising a model of a pipe network by modifying the starting proposal for a list of pipes and performing network analysis

2. Claims: 24-28

A method of determining the hydraulic significance of each of a list of pipes within a model of a pipe network

3. Claims: 29-38

A method of determining peak flow rate demands on pipes within a model of a pipe network

**Information on patent family members**

PCT/GB 01/03349

Form PCT/SA/210 (patent family annex) (July 1992)